



NASA STTR 2014 Phase I Solicitation

T5.01 Autonomous Communications Systems

Lead Center: GRC

Participating Center(s): GSFC, JPL

Future missions will require end to end communications systems that can support greater levels of autonomy and possess greater awareness of the environment and knowledge of assets that can be used for enhanced reach back and data delivery. Autonomous Communications Systems (ACS) have the potential to improve overall system performance and reduce the user burden associated with configuring and managing communications systems through the use of automated systems-level analysis and configuration control.

An ACS nominally includes the Radio/Optical subsystems and the storage and networking subsystems capable of supporting autonomous network operations. ACS capabilities would also support on-board learning to extract, catalog, and utilize information from both positive and negative experiences to enhance nominal and anomalous situations. Other desired enabling functions would include:

- Ability to increase the capabilities of on-board communications services to make network connections self-configurable and autonomous. Further advances would lead to the ability to determine how a learning system would be implemented in an on-board system, such as Artificial Intelligence.
- Ability to determine the type and how on-board information, including settings, would be exchanged between the communications components.
- Smart environment sensing capable of mitigating outages, interference and performance degradation. This could include Spectrum resource allocation and/or Dynamic frequency assignment capability to enhance throughput and connectivity.
- Low power, low cost, flexible receiver front ends that allows for efficient spectrum utilization (i.e., frequency reconfigurable) and are compatible with SDR/cognitive radio platforms allowing the use of multiple waveforms and autonomous operation to increase capacity and to enable more efficient high-data data handling and delivery, are of interest. In particular, the following enabling technologies should be addressed:
 - Frequency, pattern, polarization (FPP) agile reconfigurable antennas.
 - Dynamic impedance matching networks.
 - Digital beam forming antennas.
 - Testbeds addressing one or more of the above.

State of the Art - Current NASA flight transceivers are capable of performing communication and radiometrics. With the recent launch of the SCanTestbed on the ISS, advances in software defined radios (SDRs) that are reconfigurable are now being assessed to support communications, navigation and networking experiments and applications. However, today's flight transceivers and SDRs are not aware of their environment and do not react to it; hence lack ability to support autonomous network operations.

Background/Rationale - NASA HEOMD and SMD conduct scientific exploration that is enabled by access to space

and innovative technologies to expand mankind's understanding of planet earth and the universe. Communications and navigation technologies are integral in projecting humankind's vantage point into space with observatories in Earth orbit and deep space, spacecraft visiting the Moon and other planetary bodies, and robotic landers, rovers, and sample return missions. As the needs to gather more data and extend mankind's presence beyond low earth orbit, even more advanced communications and navigation technologies will be essential to deliver orders of magnitude more data and enable greater participation by the public through high-data rate telepresence networks.